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Feeding value of buckwheat silage for lamb as compared to maize silage

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Abstract. The alternative forages resources could help alleviating feed scarcity and improve the sustainability of ruminant production. Thus, the present study was carried out to investigate the feeding value of buckwheat (*Fagopyrum esculentum* Moench.) silage for feedlot lambs as an alternative forage source. Buckwheat harvested at the end of the milk stage was ensiled in 40 kg plastic bags after wilting and chopping. A total of 18 early weaned (2.5-3 month) Karya male lambs divided into two groups and were individually fed total mixed diets that either contains buckwheat or maize silage at dry matter (DM) proportions of 0.50 in *isonitrogenous* and *isoenergetic* diets. At the end of 63 d experiment, lambs fed the diet containing buckwheat silage had 7.6% higher DM intake ($P<0.05$) than the lambs fed the diet containing maize silage. However, live weight gain and feed efficiency was similar ($P>0.05$) for both lambs that were fed either buckwheat silage or the maize silage. No period x diet interaction was detected ($P>0.05$) for the DM and nutrient intake. The results indicated that the feeding value of buckwheat was similar or even higher than the maize silage

Keywords. Buckwheat silages – Dry matter intake – Nutritive value – Lamb.

Valeur alimentaire de l'ensilage de sarrasin pour les agneaux, comparé avec l'ensilage de maïs

Résumé. Les ressources alternatives de fourrages pourraient aider à soulager la pénurie alimentaire et d'améliorer la durabilité de la production de ruminants. Ainsi, dans ce cadre la présente étude a été réalisée pour étudier la valeur alimentaire de l'ensilage de sarrasin (*Fagopyrum esculentum* Moench) pour les agneaux d'engraissement comme une source de fourrage alternative. Cet ensilage est récolté à la fin du stade laitieux, préfané puis découpé et mis dans de sacs de 40 kg de plastique. Un total de 18 agneaux de la race Karya servés à un âge précoce (2,5-3 mois) et divisés en deux groupes ont été nourris individuellement avec une ration totale mélangée iso-azotée et iso-énergétique contenant soit le sarrasin ou l'ensilage de maïs à raison de 50% de la matière sèche (MS) totale de la ration. A la fin des 63 jours de l'essai, les agneaux alimentés de la ration contenant l'ensilage de sarrasin ont ingéré 7,6% plus de MS ($P<0.05$) que les agneaux alimentés de la ration contenant du maïs ensilage. Toutefois, le gain de poids et l'efficacité alimentaire étaient similaires ($P>0.05$) pour les deux groupes d'agneaux. Il s'est révélé aussi qu'aucune interaction période x ration n'a été détectée ($P>0.05$) pour l'ingestion de la MS et l'apport en nutriments. Les résultats indiquent que la valeur alimentaire de l'ensilage de sarrasin était similaire ou même plus élevée que celle du maïs.

Mots-clés. Ensilage de sarrasin – Ingestion de matière sèche – Valeur nutritive – Agneau.

I – Introduction

Year-round fluctuating quality and quantity of feed sources in the Mediterranean countries led researchers to explore alternative feed resources such as agro-industrial by-products in ruminant feeding (Molina Alcaide *et al.*, 2003). The quantity of agro-industrial by products is not sufficient enough to cover the forage gaps in Turkey where the shortage of roughages is estimated to be in excess of 15 million tons annually, despite the significant increases in forage production over the past decade (TUIK, 2015). The severe feed shortages force farmers to use low nutritive value cereal straw, which does not even meet the maintenance requirement. The excessive use of cereal straw in ruminant diet in turn increases the amount and/or quality of concentrate to be supplied.

mented. Therefore, alternative forage sources that can be successfully grown in a cropping system without affecting the current plant production pattern is critical for the sustainability of ruminant production in crop-livestock farming.

Common buckwheat has been a crop of secondary importance in many countries and primarily considered for grain production (Campbell, 1997). However, recently Amelchanka *et al.* (2010) and Kalber *et al.* (2011) have successfully included the common buckwheat into the diet of dairy cows. The forage production from buckwheat is quite important because it has a fast growing rate with considerable amount of dry matter (DM) production in a short period of time. Campbell (1997) reported that the DM production of up to 7 t/ha DM obtained in 6-8 weeks. Similarly, Keles *et al.* (2012) recorded 5.5 t/ha DM production from buckwheat in 48 d after sowing with 15.4% crude protein (CP) and 76.9% *in vitro* DM digestibility value in central Anatolia where continental dry climate prevailed. Furthermore, its fast growing rate allows integrating the buckwheat in crop rotation when the field is empty in sub-tropic climate.

However, there is not sufficient data available on palatability and feeding value of buckwheat silages in small ruminant. Therefore, the main objective of this study was to compare the palatability and feeding value of buckwheat to maize silage considered as a commonly used forage source with palatable and high in feeding value.

II – Material and methods

1. Silage production

This study was carried out at Adnan Menderes University, Faculty of Agriculture (37° 45' N, 27° 45' E, 38 m above sea level) located in Aydin, Turkey in May-July 2014. Following cultivation and seed bed preparation, buckwheat (*Fagopyrum esculentum* Moench.) was sown on the 29th of August 2013 using a commercial drill at a seeding rates of 60 kg/ha. Buckwheat was cut a stubble height of 5 cm from ground level at the phenological stage when the most of the seed were in milk stage, which was 49 d after from sowing. After wilting approximately 20 h, the swards harvested and chopped with silage machine (Double chop, Fimaks, Bursa, Turkey) and ensiled in plastic bags using vacuum without any additives. Approximately 40-45 kg fresh material was ensiled in each bag. After 7-9 m of ensiling under shelter, each bags was sampled and fed out for 3-4 d. Maize silages used in experiment were taken from farm bunker silos daily.

2. Pen feeding experiment

Pen feeding experiment was carried out with a total of 18 homogeneous early weaned (2.5-3 month of age) male Karya lambs with average initial body weight of 21.6 ± 1.2 kg. Lambs were randomly divided into two equal groups and assigned to their individual pens (1.2 x 1.7 m) equipped with plastic feed container. They had *ad libitum* access to fresh water. Lambs were allowed a 12-d acclimation to their diet. The feeding experiment continued for 63 days in three periods each lasting for 21 days.

Silages were mixed with one of two assigned concentrate to compose a total mixed diets with a DM portion of 0.5. Buckwheat silage was mixed with a concentrate with its crude protein (CP) and metabolizable energy (ME) content was 17.3 % and 3.07 Mcal/kg DM, respectively, whereas maize silage was mixed with a concentrate with its CP and ME content was 22.5 % and 2.82 Mcal/kg DM, respectively. The two concentrate were manufactured at the feed unit of the Agricultural Faculty to make the diets *isonitrogenous* and *isoenergetic*. Because of nutritional differences of silages (Table 1), the concentrate prepared for mixing the maize silage group had lower maize grain (41.8%) and had additional protein source (30.4%, cotton seed meal). The concentrate prepared for mixing the buckwheat silage group composed of only maize grain (73.2%) and soybean meal (24%) which was included at a similar level to maize silage concentrate (25%). Other diet ingre-

dients (vitamin-mineral) were the same in the concentrates. The diets prepared daily and were offered 1.1 of DM intake (previous week) once a day (0900). The DM of total diets offered and refusals were determined to calculate the DM intake.

Table 1. Nutritive value of the silages, % in DM

	OM	EE	CP	NDIN	ADIN	NDF	ADF	ADL	ME
Maize silage	94.1	2.6	7.5	0.6	0.4	50.9	27.3	3.9	2.18
Buckwheat silage	89.8	2.9	12.7	1.5	0.8	47.2	38.1	9.5	1.92

Lamb weights were recorded at the beginning of the trial and at 21 d intervals thereafter following the lambs being fasted for 12 h. *In vivo* diet nutrient digestibility was determined indirectly using acid-insoluble ash as an indigestible dietary marker, as described by Van Keulen and Young (1977). Standard analytical procedures were applied to determine the nutritive value of feedstuff (AOAC, 1990; Van Soest *et al.*, 1991). Metabolizable energy (ME) of feedstuff was calculated according to NRC (2001). The comparisons between the groups were performed by independent *t* test using the general linear model procedure of SPSS 10.

III – Results and discussion

The major nutrient contents of buckwheat silage were similar to the findings of Amelchanka *et al.* (2010), but lower than our previous experiment (Keles *et al.*, 2012) with 15.4 and 34.7% CP and NDF, respectively when harvested at the beginning of the milk stage, after sowing 48 day in Central Anatolia. Apparently, as a fast growing crop, buckwheat had a more rapid change in nutritive value than leguminous or even forage cereals with maturity, and change in nutritive value is more pronounced after the formation of its triangle shaped seeds.

Table 2. Dry matter and nutrient intake, digestibility of diets and growth performance of lambs

Intake, g/d	Buckwheat silage	Maize silage	SEM	P-value
Dry matter	947 ^a	880 ^b	22.5	0.001
Crude protein	145 ^a	133 ^b	3.4	0.014
NDF	261 ^a	359 ^b	7.9	0.001
Digestibility, %				
Dry matter	70.3	62.7	0.90	0.001
Organic matter	71.9	63.6	0.97	0.001
Crude protein	64.5	55.7	1.17	0.002
NDF	52.5	42.7	2.50	0.031
Performance				
Liveweight gain, g/d	182	178	7.2	0.715
Efficiency	5.4	5.2	0.3	0.531

The primary reason for using high forage level in this experiment was to make a better comparison of buckwheat silages with a commonly used palatable forage source in term of their palatability and feeding values for a long time study. The intake, growth performance and digestibility of diets are presented in Table 2. The DM intake of lambs that consumed buckwheat containing diet was higher than ($P<0.001$) the lambs consumed maize silage containing diets. Feeding the dairy cows in low (10%, Amelchanka *et al.*, 2010) or high (48%, Kalber *et al.*, 2011) level of dietary buckwheat silages showed no effect on the intake and milk yield in the relatively short term experiments. The lambs that consumed buckwheat containing diet consumed more DM intake in the current long

term experiment (73-d). These results showed that buckwheat silages is palatable and can constitute half of the ruminant diets without any detrimental effect on ruminant performance and health with prolonged duration of feeding.

One of the features of the results was that buckwheat had quite low hemicellulose content (9.5%) as reported by both Amelchanka *et al.* (2010) and Keles *et al.* (2012) previously. This could be associated with the lower digestibility values as most of the cell wall content (NDF) is made up from less digestible lignocellulose (ADF) and indigestible lignin. However, even total diet containing buckwheat silages higher ADF and lignin contents, *in vivo* digestibility of diets DM, organic matter, CP and NDF was higher in lambs fed buckwheat containing diets than those fed maize silage. Therefore, lambs preferred more digestible diets. As a result of higher DM intake of the lambs fed buckwheat silages, their nutrient intake was also higher than the lambs fed maize silage containing diets. But the differences were not sufficient to affect the lamb's liveweight gain in *isonitrogenous* and *isoenergetic* diets.

IV – Conclusions

With suitability to fed long term, its high palatability and digestibility values together with its moderate nutrient content (moderately high CP and moderate cell wall content when compared to common forage source) make the buckwheat as a valuable forage source. Furthermore, its fast growing rate allows producing buckwheat without affecting the main crops especially in sub tropic climate. The first year results of field experiment (unpublished, continuous) conducting in the same experimental area showed that buckwheat is suitable for forage production in both spring and autumn seasons without affecting the main forage production (winter cereals in winter, maize for silage in summer).

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